(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 April 2002 (18.04.2002)

PCT

(10) International Publication Number
WO 02/31312 A2

(51) International Patent Classification[7]: E21B

(21) International Application Number: PCT/IB01/02105

(22) International Filing Date: 9 October 2001 (09.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0024909.4 11 October 2000 (11.10.2000) GB

(71) Applicant and
(72) Inventor: SPRINGER, Johann [AT/AT]; Dauphinestrasse 22, A-4030 Linz (AT).

(74) Agents: MOLYNEAUX, Martyn, W. et al.; Wildman, Harrold, Allen & Dixon, 11th Floor, Tower 3, Clements Inn, London WC2A 2AZ (GB).

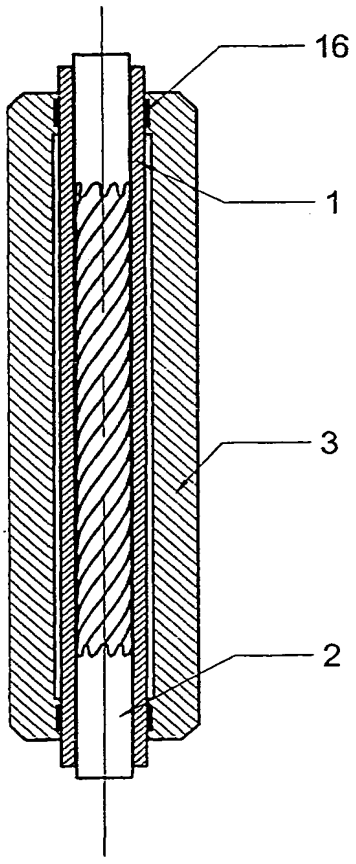
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

[Continued on next page]

(54) Title: DRILL STRING MEMBER



(57) Abstract: A drill string member is formed by providing a former (2) and a cylindrical member (1) to be shaped in relationship with the former. Seals (20) are provided between opposing ends of a thick wall cylinder (3) and the cylindrical member, a pressure is applied in the annulus (4) between the cylindrical member and the thick wall cylinder sufficient to deform the cylindrical member against the former. The drill string member thus formed has a constant wall thickness and a non-circular former provides a non-circular drill string member.

WO 02/31312 A2

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DRILL STRING MEMBER

This invention relates to a drill string member and particularly to a drill string member arranged to alleviate or prevent differential sticking downhole.

It is known from the Society of Petroleum Engineers, Paper SPE22549, "Differential Sticking Laboratory Tests can improve Mud Design" by M. Bushnell-Watson and S.S. Panesar, presented to the 66th Annual Conference and Exhibition of the Society of Petroleum Engineers held in Dallas, Texas, October 6 - 9, 1991, that differential sticking occurs when a drill pipe, or logging tool, becomes embedded in mud filter cake and where the drill pipe or filter tool is held by the mud overbalance pressure. Once sticking has occurred, a large force is required to free the drill pipe, even if the mud overbalance is removed. Such sticking causes several hours of rig time being spent in attempting to free the drill pipe. In severe cases, the drill pipe cannot be freed and the well has to be sidetracked or abandoned. In the disclosure, a laboratory method is disclosed for freeing differentially stuck pipes with sheer and changes are proposed to the mud chemistry. As disclosed in the Society of Petroleum Engineers, Paper SPE14244, "A New Approach to Differential Sticking" by J.M. Courteille and C. Zurdo, presented at the 60th Annual Technical Conference and Exhibition of the Society of Petroleum Engineers held in Las Vegas, Nevada, September 22 - 25, 1985, differential sticking has a high risk of occurrence in deviated wells and the paper describes recording the pressure at different points of the pipe/cake

and cake/formation interfaces in a laboratory device. It is also known from, for example, US-A-4811800 to produce a flexible drill string member for use in directional drilling in which the member has a spirally-shaped outer surface so as to make the member more flexible at traversing bends in boreholes. Such a member is formed from a steel tube which has the outer surface thereof machined to form a spiral. The wall thickness, therefore, varies.

US-A-6012744 discloses a heavy weight drill pipe which also incorporates tubular members having spirally formed external surfaces and the spirally formed members are taught to reduce the chances of differential pressure sticking of the pipe when the pipe is used in a high angle or horizontal well bore.

Forces involved in the occurrence of differential sticking are substantially proportional to the area of a drill string element embedded in the filter cake. It will be understood by those skilled in the art that the filter cake is formed on the borehole wall when drilling through permeable formations. A reduction in the area of contact between the filter cake and the drill string element is thus a major objective of the spirally formed external surface of the member disclosed in US-A-6012744.

By using a spiral formation with a right hand thread, in high angle holes, cuttings may be lifted into the main stream of the flowing mud and such right hand spiral designs increase the load effective at the bit by "screwing" the string towards the bit end while cuttings that have not been lifted into the main stream mud are

pushed upwards along the low side of the hole in the manner of an Archimedian screw pump.

Such spirally formed members of the prior art have internal cross-sections which are cylindrical and with an outer surface of varying diameters which vary along the drill string longitudinal axis. The manufacturing process of drill string members such as drill pipes, intermediate weight drill string elements and heavyweight drill pipe elements, as well as drill collars having a non-circular cross-section for at least a part of their axial length, requires costly and time-consuming external removal of metal by milling. In addition, eventual drilling a long cylindrical bore may also be required when using an initially solid bar stock to produce the above-mentioned devices.

The present invention seeks to provide a drill string member having an external surface of varying diameters which is more readily produced.

According to one aspect of this invention, there is provided a method of forming a drill string member including the steps of providing a former, providing a cylindrical member to be shaped in relationship with the former, providing sealing means at opposing ends of the cylindrical member and the former, and applying a pressure sufficient to plastically deform said cylindrical member against said former, whereby a substantially constant wall thickness about the circumference of the cylindrical member is provided.

According to a feature of this invention, there is provided a method of forming a drill string member

including the steps of providing an external cylinder, inserting a core in a cylindrical tubular member, said core having a desired shaped external surface for the walls of said tubular member, locating the cylindrical tubular member and core in the external cylinder, sealing the tubular member at its remote ends, applying a pressure to an annulus formed between the cylinder and the tubular member sufficient to plastically deform the tubular member against the externally shaped surface of the core, whereby the walls of the tubular member have a substantially constant thickness about the periphery of the tubular member, and removing the seals and core.

According to another feature of this invention, there is provided a method of forming a drill string member including the steps of providing a former having an internal surface corresponding to a shape to be formed, providing a cylindrical tubular member to be shaped inside said former, providing sealing means at opposing ends of the tubular member, applying a pressure to the inside of said tubular member sufficient to plastically deform said tubular member against the internal surface of said former, whereby said deformed tubular member has a substantially constant wall thickness about the circumference thereof.

Preferably, portions having a circular cross-section are located at opposing ends of the plastically deformed tubular member.

Preferably, the pressure applied is produced by one of hydro-forming and explosive-forming.

Advantageously, after plastically deforming said tubular member it is heat treated to relieve stresses.

According to another aspect of this invention there is provided a drill string member arranged to at least alleviate differential sticking and/or to facilitate the transport of cuttings in at least one of a high angle and a horizontal well bore including at least one tubular member having a portion with a non-circular internal and external cross-section, whereby a substantially constant wall thickness about the circumference thereof is provided.

Preferably, opposing end portions of said non-circular portion are provided having a substantially circular cross-section.

Advantageously, said non-circular portion has an undulating outer surface with crests and troughs extending across a longitudinal axis of said member.

In a preferred embodiment, said crests and troughs form a spiral groove in a wall of said member.

Preferably, said spiral groove is a right hand spiral.

Alternatively, said crests and troughs extend along a longitudinal axis of said member.

Advantageously, tool joints are secured by, for example, friction welding to said circular end portions.

Advantageously, said member has two or more crests, advantageously three to eight crests and, preferably, six crests are provided in a plane transverse to a longitudinal axis through said non-circular portion.

Advantageously, plural said tubular members are provided in a drill string, each interconnected by an interconnecting member having a substantially constant external diameter.

According to yet a further feature of this invention, said drill string member is used as one of a drill pipe, an intermediate weight drill pipe, a heavyweight drill pipe, a drill collar, and a wash-over pipe.

According to a further aspect of this invention there is provided a drill string member made as defined herein above and used to at least alleviate differential sticking, said member being in accordance with said another aspect.

According to yet another aspect of this invention there is provided a drill string member including at least one tubular member having a portion with a non-circular internal and external cross-section, whereby a substantially constant wall thickness about the circumference thereof is provided.

The drill string member of the present invention improves the transport of cuttings from downhole in at least one of a high angle and a horizontal well bore, especially when formed in a spiral configuration.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a transverse cross-section through an apparatus for forming a drill string member in accordance with this invention in a first step of formation,

Figure 2 shows a further step in forming the drill string member in accordance with this invention,

Figure 3 shows another step in the formation of the drill string member in accordance with this invention,

Figure 4 shows a cross-sectional view of a drill string member formed in accordance with this invention,

Figure 5 shows a transverse cross-section through another apparatus for forming a drill string member in accordance with this invention in a first step of formation,

Figure 6 shows a further step of forming the drill string member using the apparatus of Figure 5,

Figure 7 shows a side view of plural drill string members each formed in accordance with this invention mounted in situ in a drill string.

Figure 8 shows a side view of a further drill string member formed in accordance with this invention,

Figure 9 shows another drill string member formed in accordance with this invention, and

Figure 10 shows a longitudinal cross-section of the assembly shown in Figure 4.

In the Figures like reference numerals denote like parts.

Figures 1, 2 and 3 show stages in forming a drill string member in accordance with a first embodiment of this invention.

Figure 1 shows a cylindrical tubular member to be deformed and an axially split core 2 is inserted into the member 1, the core being a former having a desired external shape to which the member 1 is to be formed. The core 2 has a forming portion of the desired configuration with circularly cross-sectioned opposing end portions, the outside diameters of which correspond substantially with the internal diameter of member 1. The forming portion of the core may have peaks and troughs extending substantially Parallel to the longitudinal axis of the core/tubular

member or, preferably, the peaks and troughs extend along and across a longitudinal axis of the core/tubular member in a spiral formation, advantageously a right hand spiral. The core 2 is arranged to fit inside the inside diameter of the member 1, but is arranged that a forming non-cylindrical section does not extend over the extreme ends of the member 1 so that the extreme ends remain unformed. The member 1 and core 2 are inserted into a pressure chamber formed by a thick walled cylinder 3 and seals 16 (shown in Figure 10). Fluid, preferably liquid, is inserted into the annulus between the member 1 and cylinder 3 and high pressure is applied so as to deform the member 1 inwardly to take the shape of the external surface of the core 2 (as shown in Figure 2).

The seals and fluid are removed to provide the configuration shown in Figure 3 and the core is then removed to provide the member shown in Figure 4.

Although the core is, preferably, a split core, it is to be understood that such a configuration is not essential, as will be understood by those skilled in the art. Although a six-lobed cross-section for the core is preferred, i.e. a core having six crests, it is to be understood that other configurations may also be desired if required. Thus, what is required is that at least one crest is provided, two crests being an ellipse, three crests forming a triangular shape, four crests a square, etc., but it is desired that the form has well rounded edges.

The tubular member 1 is, thus, plastically deformed and, although in the embodiment above-described, the ends

of the member 1 are not deformed, the whole of the member 1 may be deformed if desired.

Instead of hydro-deforming the tubular member 1, it may, alternatively, be explosively deformed.

After the step of Figure 3, the tubular member 1 has a configuration, as shown in Figure 4, and the member may be heat treated to relieve stresses caused by the forming process.

If the walls of the tubular member 1 are very thick, deforming at ambient temperature may not be possible or may be possible only with very expensive pressure pumping systems. In such instances, it may be necessary to heat the member 1 to reduce the forces required for deformation.

The cylindrical ends of the member are threaded for connection to other tubular members of a drill string. The member 1 may be used as a wash-over pipe for open-hole wash-over operations to avoid differential sticking. Conventional wash-over pipe generally has a diameter which is very close to a well diameter. The contact area between the pipe and the filter cake, one of the factors determining the likelihood of the pipe becoming differentially stuck, is, therefore, drastically increased in comparison to smaller outside diameter tubular elements. As wash-over pipe made in accordance with the present invention considerably reduces the contact area and, therefore, virtually eliminates the risk of differential sticking when washing over a stuck drill string.

To prepare the formed pipe for further manufacturing steps, the wall thickness of the cylindrical end of the pipe (member 1) may be increased by creating external

and/or internal upsets. Such a process is usual in drill string manufacturing industry and is followed by heat-treating the pipe. The upset pipe may be threaded and used as special, tool jointless tubular elements such as wash-over pipe.

In an alternative embodiment for forming a drill string member in accordance with this invention, shown in Figures 5 and 6, the tubular member 1, prior to deformation, is inserted into a thick walled former 5 having an internal surface configured to the shape desired for the member 1. The ends of the member 1 are sealed and liquid 6 is pumped under high pressure into the member 1. It will be noted from Figure 5 that the outside diameter of the member 1 abuts the crests of the internal shape of the former 5. The liquid is subjected to high pressure causing the member 1 to plastically deform outwardly, as shown in Figure 6, the seals and former are removed to provide a member, as previously shown in Figure 4.

In another embodiment of the invention, male and female tool joints are friction welded to opposing ends of the cylindrical portions of the member 1, preferably upset ends of the formed pipe body, thereby creating tubular drill string members such as drill pipe, heavyweight pipe and intermediate weight pipe elements. The tool joints may have the same diameter or, for handling purposes, at least slightly larger diameter than an adjacent cylindrical pipe section. The tool joints may be larger, identical to or smaller in outside diameter than the non-circular portion of the pipe body for drill pipe and heavy wall pipe. For larger outside diameter drill string elements, the outside

diameter should, preferably, be of the same diameter as the tool joints or only slightly smaller than the tool joints (external pressure formed elements) or slightly larger than the tool joints (internal pressure formed elements) to reduce bending stresses and wear in the tool joint area.

In general, the diameter of a circle inscribed in the cross-section of the non-circular section of the member 1 should be not smaller than the inside diameter of the tool joints. If the manufacturing process or the desired external shape of the pipe should result in a smaller diameter of the inscribed circle, metal may need to be removed from the inside of the pipe by boring or on a lathe. A member so modified is intended to be within the scope of the present invention.

In some instances it may be necessary to cover the crests on some portions of the non-circular portion of pipe with a protective layer of hard metal for increased wear resistance. Conversely, to obtain an evenly thick layer of hard metal, the outside diameter of the member may be slightly reduced on a lathe prior to applying the hard metal layer. A member treated in such a manner is also within the scope of the present invention.

Referring to Figure 7, plural members 1, each formed in accordance with this invention, are serially connected in a drill string. The uppermost member 1 has a circular cross-section portion 8 having the same configuration to the initial cylindrical tubular member before deformation and the deformed member has four lobes 9 each extending longitudinally of the member 1. A top, remote end of the member 1 has a female top connection joint 7 secured to the

member 1 by, for example, friction welding. The intermediate member 1 has a six-lobed configuration, each of which extend longitudinally of the member 1. A bottom member 1 has four lobes 11 which are helically formed about the member 1 and a male joint 12 is connected to one end of the bottom member 1 by, for example, friction welding. Each of the members 1 are interconnected by mating threaded tool joints (not shown). Each of the lobe formations of the members 1 are formed in a manner described above.

In Figure 8, a tubular member 1 has a circular cross-section portion 13 forming an elevator and slip recess. The member 1 has six lobes 14 which are indented from the initially provided cylindrical member and are formed in accordance with this invention.

The embodiment shown in Figure 9 has a member 1 with a helical formation of six lobes 15 which are indented from the initially provided circular member and are formed in accordance with this invention.

Thus, the present invention provides a less expensive manner of forming a drill string member which is useful for preventing differential sticking.

CLAIMS:

1. A method of forming a drill string member including the steps of providing a former, providing a cylindrical member to be shaped in relationship with the former, providing sealing means at opposing ends of the cylindrical member and the former, and applying a pressure sufficient to plastically deform said cylindrical member against said former, whereby a substantially constant wall thickness about the circumference of the cylindrical member is provided.

2. A method of forming a drill string member including the steps of providing an external cylinder, inserting a core in a cylindrical tubular member, said core having a desired shaped external surface for the walls of said tubular member, locating the cylindrical tubular member and core in the external cylinder, sealing the tubular member at its remote ends, applying a pressure to an annulus formed between the cylinder and the tubular member sufficient to plastically deform the tubular member against the externally shaped surface of the core, whereby the walls of the tubular member have a substantially constant thickness about the periphery of the tubular member, and removing the seals and core.

3. A method of forming a drill string member including the steps of providing a former having an internal surface corresponding to a shape to be formed, providing a cylindrical tubular member to be shaped inside said former,

providing sealing means at opposing ends of the tubular member, applying a pressure to the inside of said tubular member sufficient to plastically deform said tubular member against the internal surface of said former, whereby said deformed tubular member has a substantially constant wall thickness about the circumference thereof.

4. A method as claimed in claims 1, 2 or 3, wherein portions having a circular cross-section are located at opposing ends of the plastically deformed tubular member.

5. A method as claimed in any preceding claim, wherein the pressure applied is produced by one of hydro-forming and explosive-forming.

6. A method as claimed in any preceding claim, wherein after plastically deforming said tubular member it is heat treated to relieve stresses.

7. A drill string member arranged to at least alleviate differential sticking and/or to facilitate the transport of cuttings in at least one of a high angle and a horizontal well bore including at least one tubular member having a portion with a non-circular internal and external cross-section, whereby a substantially constant wall thickness about the circumference thereof is provided.

8. A drill string member as claimed in claim 7, wherein opposing end portions of said non-circular portion are provided having a substantially circular cross-section.

9. A drill string member as claimed in claim 7 or 8, wherein said non-circular portion has an undulating outer surface with crests and troughs extending across a longitudinal axis of said member.

10. A drill string member as claimed in claim 9, wherein said crests and troughs form a spiral groove in a wall of said member.

11. A drill string member as claimed in claim 10, wherein said spiral groove is a right hand spiral.

12. A drill string member as claimed in claim 10 or 11, wherein said crests and troughs extend along a longitudinal axis of said member.

13. A drill string member as claimed in any of claims 7 to 12, wherein tool joints are secured by, for example, friction welding to said circular end portions.

14. A drill string member as claimed in any of claims 7 to 13, wherein said member has two or more crests.

15. A drill string member as claimed in any of claims 7 to 13, wherein said member has three to eight crests.

16. A drill string member as claimed in any of claims 7 to 13, wherein said member has six crests in a plane

transverse to a longitudinal axis through said non-circular portion.

17. A drill string member as claimed in any of claims 7 to 16, wherein plural said tubular members are provided in a drill string, each interconnected by an interconnecting member having a substantially constant external diameter.

18. A drill string member as claimed in any of claims 7 to 17, wherein said drill string member is used as one of a drill pipe, an intermediate weight drill pipe, a heavyweight drill pipe, a drill collar, and a wash-over pipe.

19. A drill string member made in accordance with any of claims 1 to 6 and used to at least alleviate differential sticking said member including at least one tubular section having a portion with a non-circular internal and external cross-section, whereby a substantially constant wall thickness about the circumference thereof is provided.

20. A drill string member including at least one tubular section having a portion with a non-circular internal and external cross-section, whereby a substantially constant wall thickness about the circumferenece thereof is provided.

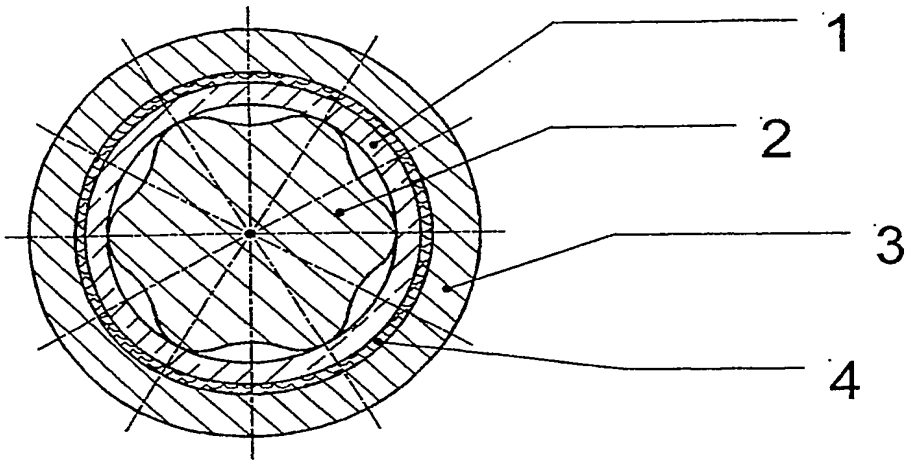


Fig. 1

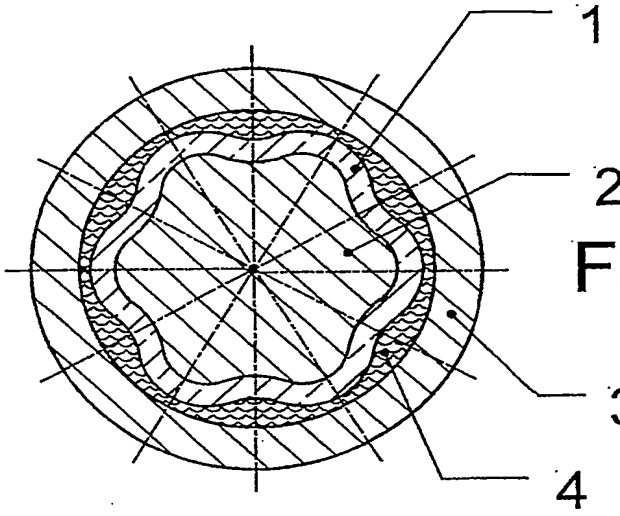


Fig. 2

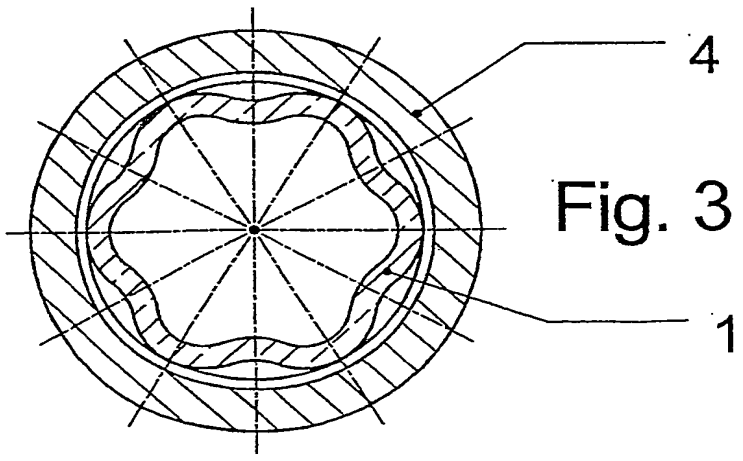


Fig. 3

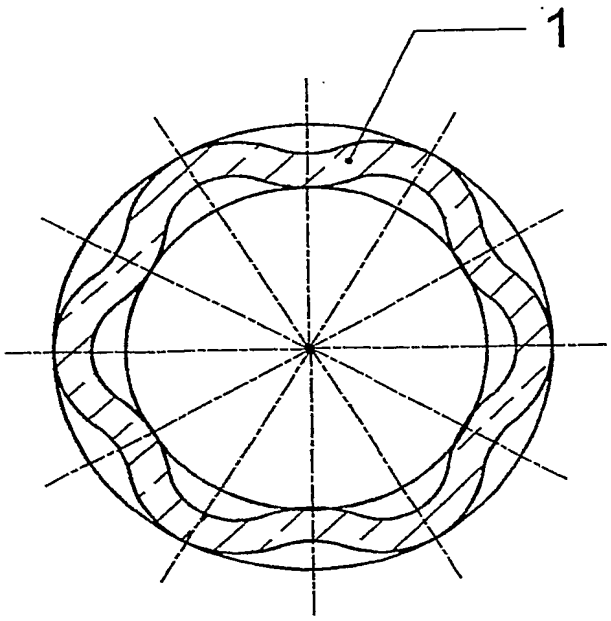


Fig. 4

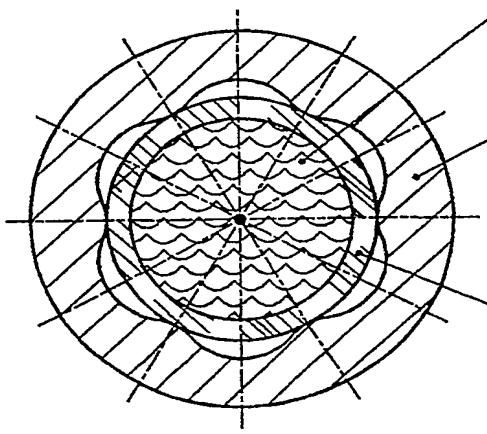


Fig. 5

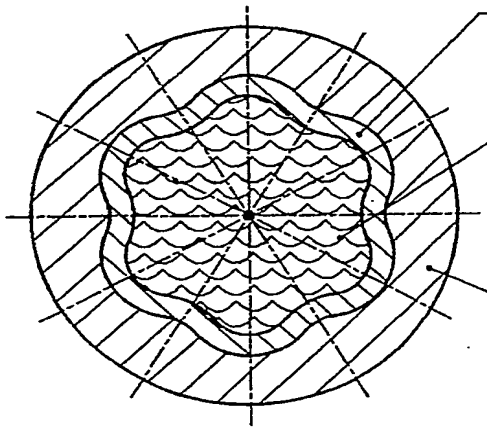


Fig. 6

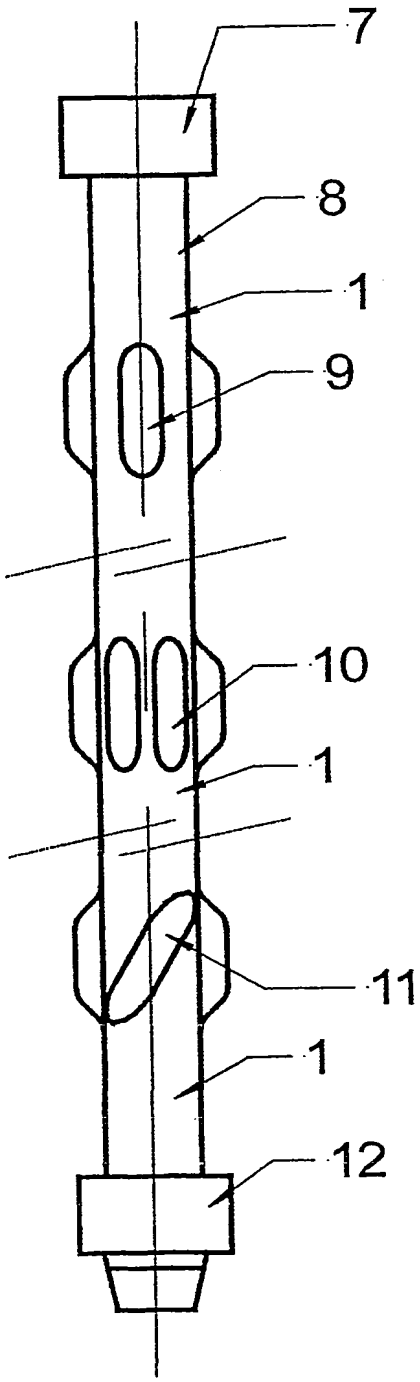


Fig. 7

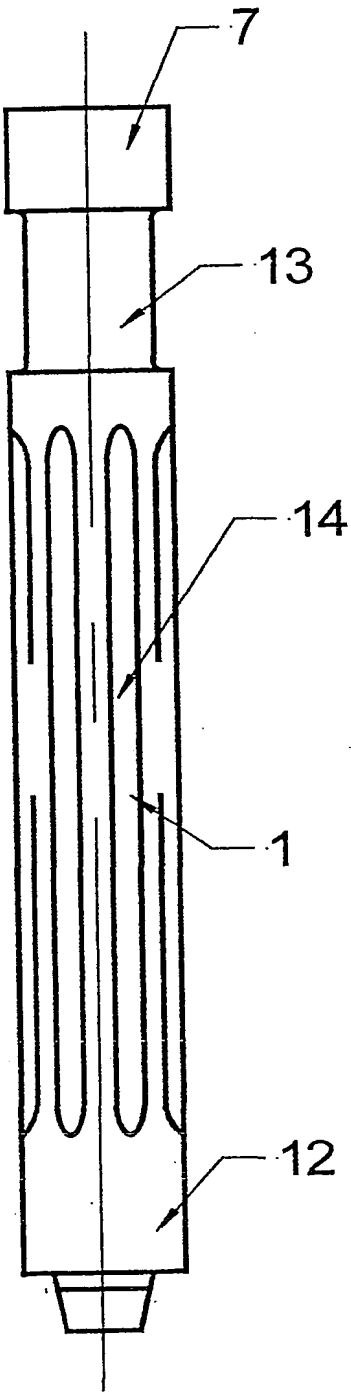


Fig. 8

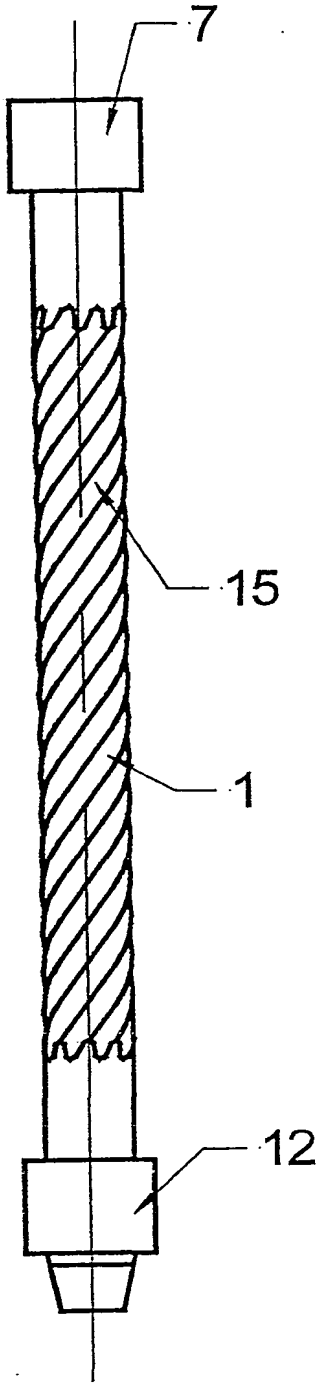


Fig. 9

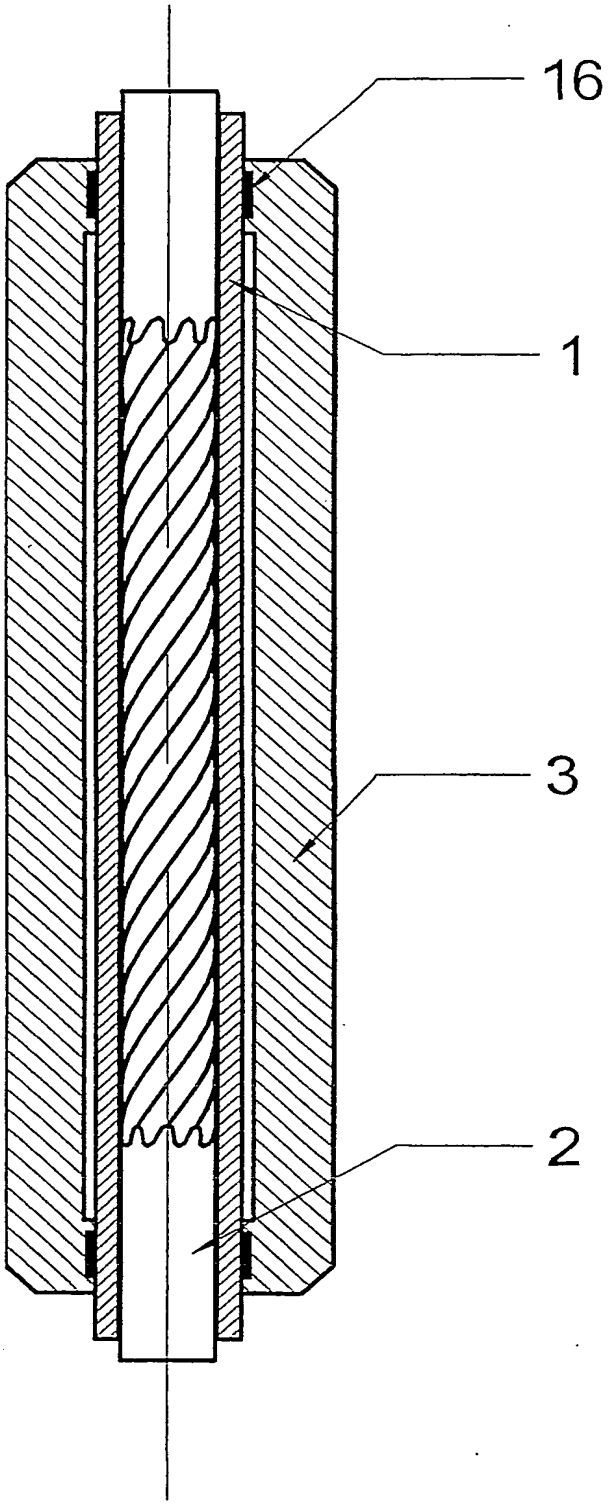


Fig. 10

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 April 2002 (18.04.2002)

PCT

(10) International Publication Number
WO 02/031312 A3

(51) International Patent Classification[7]: E21B 17/16, 17/22, B21D 26/02, 26/08

(21) International Application Number: PCT/IB01/02105

(22) International Filing Date: 9 October 2001 (09.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0024909.4 11 October 2000 (11.10.2000) GB

(71) Applicant and
(72) Inventor: SPRINGER, Johann [AT/AT]; Dauphinestrasse 22, A-4030 Linz (AT).

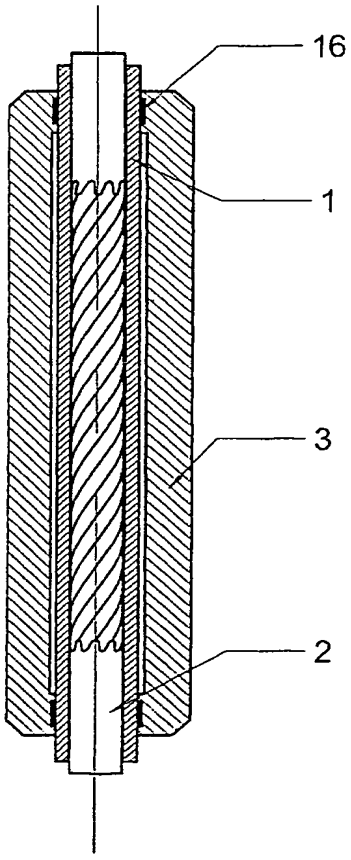
(74) Agents: MOLYNEAUX, Martyn, W. et al.; Wildman, Harrold, Allen & Dixon, 11th Floor, Tower 3, Clements Inn, London WC2A 2AZ (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF,

[Continued on next page]

(54) Title: DRILL STRING MEMBER



(57) Abstract: A drill string member is formed by providing a former (2) and a cylindrical member (1) to be shaped in relationship with the former. Seals (20) are provided between opposing ends of a thick wall cylinder (3) and the cylindrical member, a pressure is applied in the annulus (4) between the cylindrical member and the thick wall cylinder sufficient to deform the cylindrical member against the former. The drill string member thus formed has a constant wall thickness and a non-circular former provides a non-circular drill string member.

WO 02/031312 A3

CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:
1 August 2002

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 01/02105

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B17/16 E21B17/22 B21D26/02 B21D26/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 771 811 A (DECELL ALONZO L ET AL) 20 September 1988 (1988-09-20) column 2, line 14 - line 38; figures 1,,1A	1-3
A	GB 1 345 924 A (VALLOUREC LORRAINE ESCAUT) 6 February 1974 (1974-02-06) page 1, line 67 - line 78	1-3
A	US 5 203 190 A (KRAMER ROY W ET AL) 20 April 1993 (1993-04-20) claim 1; figures 1,2	1,3
A	US 4 751 836 A (BREESE PETER) 21 June 1988 (1988-06-21) claim 1; figures 1,2	1,3

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 January 2002	06.06.02

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bellingacci, F

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 01/02105

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 889 506 A (SHAFFER JOHN RICHARD) 17 June 1975 (1975-06-17) abstract -----	1,2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 01/02105

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-6, 19

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6, 19

   Method of forming a drill string member by pressing a cylindrical member against a former

2. Claims: 7-18, 20

   Drill string member having a portion with non circular internal and external cross sections and constant wall thickness

INTERNATIONAL SEARCH REPORT

Interna[redacted]l Application No
PCT/IB 01/02105

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 4771811	A	20-09-1988	US	4674171 A	23-06-1987
			CA	1317930 A1	18-05-1993
GB 1345924	A	06-02-1974	FR	2107804 A5	12-05-1972
			CA	964496 A1	18-03-1975
			CS	161136 B2	04-05-1975
			DE	2146308 A1	20-04-1972
			HU	162503 B	28-02-1973
US 5203190	A	20-04-1993	NONE		
US 4751836	A	21-06-1988	NONE		
US 3889506	A	17-06-1975	CA	1028842 A1	04-04-1978
			JP	50130673 A	16-10-1975